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Air Conditioner Requirements Validation Review of Corps/Theater ADP Service Center or CTASC-II

by
Gregory F. Brainard

Report Date
May 1992

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United States Army
Belvoir Research, Development and Engineering Center
Fort Belvoir, Virginia 22060-5606

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This report assesses the tactical electric and cooling requirements of the Mobile Subscriber Equipment (MSE) system for the "Air Conditioner Requirements Review Program."			
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**US Army Belvoir RD&E Center
Fort Belvoir, Virginia 22060-5606**

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Section I

Background

The U. S. Army's Troop Support Command (TROSCOM) and Training and Doctrine Command (TRADOC) initiated the "Air Conditioner Requirements Review Program" to establish requirements for a new generation of environmental control equipment. TRADOC's Ordnance School; and TROSCOM's Special Programs Management Office; and Belvoir Research, Development, and Engineering Center (BRDEC), Systems Assessment Team were the program's primary participants. The Systems Assessment Team was directed to assess the electric power and cooling requirements of selected Army systems. To assist in this effort, a Special Sample Data Collection (SSDC) Project was established under the auspices of the TROSCOM Sample Data Collection Program. The SSDC Project inventories each system, paves the way for the assessment, and conducts operator interviews regarding the effectiveness of existing electric power and cooling equipment. Systems to be assessed include: DAS-3, MSE, TACMIS, FAADS, SICPS, and Patriot.

Section II

Approach

It is necessary to account for electrical power demand when determining the cooling load of a system. This process involves three steps:

First, all power consuming equipment in the system's shelter must be inventoried. This includes collecting the manufacturer's nameplate data and inspecting manuals for each item.

Second, the system's power consumption must be measured while equipment items, groups, and the entire system are powered-up and powered-down. From this data, the power demand of each piece of equipment and a predicted maximum system power demand can be derived. This technique includes power conditioner losses with the supported equipment's power demand.

Finally, the shelter's thermal characteristics, and personnel and tactical requirements must be entered into the Shelter Systems Assessment Model (SAM). The model can then determine cooling loads and Environmental Control Unit (ECU) suitability under hypothetical ambient conditions. When test conditions allow, the ECU needs should be validated using temperature data taken during the test and by interviewing experienced system operators.

Section III

System Description

CTASC-II will provide Automatic Data Processing (ADP) functions on the Corps/Theater level. Designated AN/MYQ-6, CTASC-II requires three shelters mounted on Commercial Utility Cargo Vehicles (CUCVs). These shelters resemble Standardized, Integrated Command Post Shelters (SICPS) and could be replaced by them later. The shelters are: Communications Central (AN/MSC-75), Computer System Digital (AN/MSQ-122), and a Support Shelter (AN/MYM-1).

Cooling for the Communication Central and Computer System Digital shelters is provided by a trailer-mounted 36 kBtuH horizontal air conditioner. Flexible ducting distributes cooling to both shelters. The Support Shelter uses a 9 kBtuH horizontal air conditioner.

Field power comes from the headquarters generator. In garrison, CTASC-II uses commercial power sources. The system tested for this report is attached to the Regional Support Facility, Alexandria, VA, and is assigned a 45 kW, 60 Hz generator set. An illustration of its layout is given in Figure 1.

CTASC-II equipment is listed in Table 1. The AN/MSC-75 shelter includes communications, electronic security, archiving, data processing, lighting, and other equipment. The AN/MSQ-122 shelter contains a large data storage facility, support equipment, lighting, and communications. Each shelter also contains a humidifier and a resistance heater. The AN/MYM-1 shelter is used primarily for storage and its cooling needs are not analyzed.

The AN/MSC-75 shelter requires two operators during normal operation, and the AN/MSQ-122 requires one.

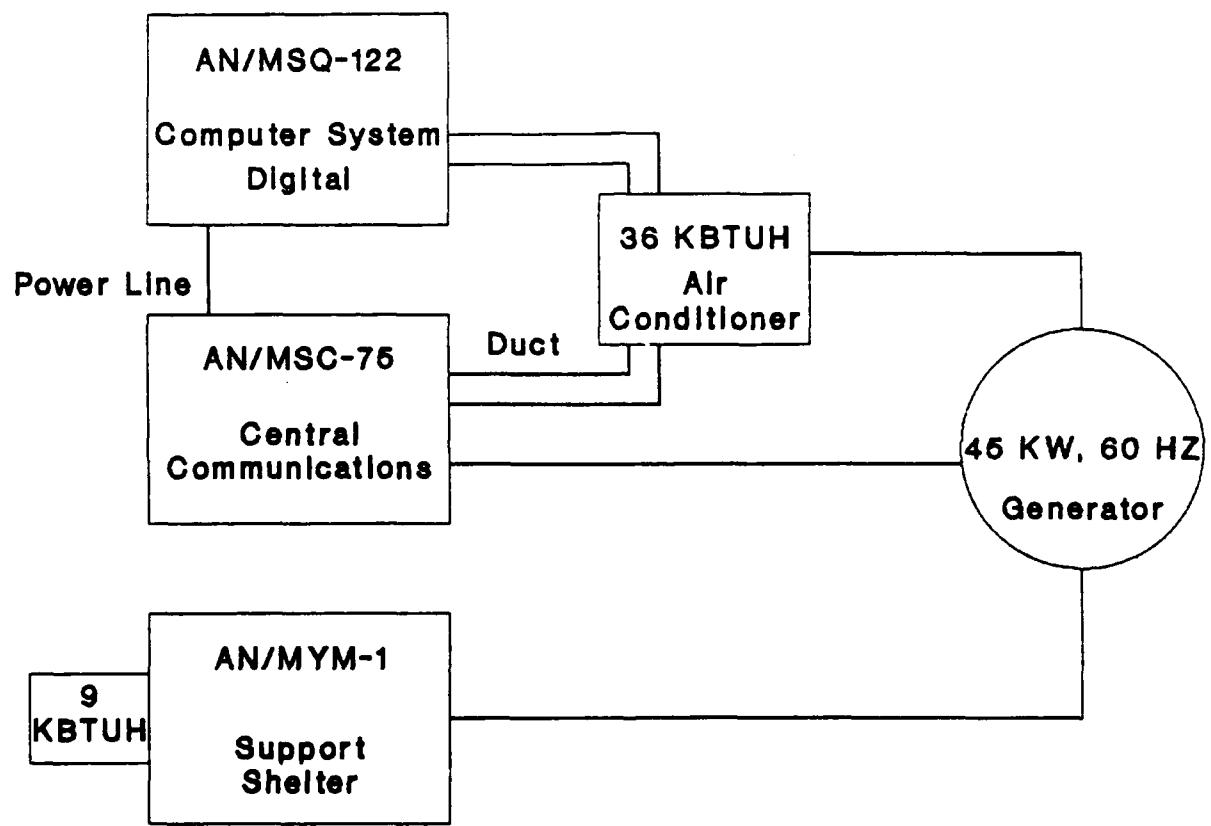


Figure 1. CTASC-II System Layout

Section IV

Discussion

An inventory of CTASC-II was performed (pages 4 and 5 of the Appendix). Each piece of power consuming equipment was listed as a column heading on a Power Measurement Load Configuration form (Figure 2 in the Appendix). The test began with all equipment turned off. Then, the test team took total power consumption readings from the power source while an operator turned various groupings of equipment on and off. The readings were entered in a Power Generator Performance form (Figure 3 in the Appendix).

The power consumed by each item is derived from the changes in total generator power demand. The results are listed in Table 1.

After the power consuming equipment was identified and each item's demand measured, the data was entered into the SAM. Figure 2 shows the results of computer runs representing internal temperatures of 85°F. 85°F was chosen because of electronic equipment's sensitivity to temperature. Internal relative humidity was held to no greater than 60%. The ambient conditions represent environment 1 as specified in AR 70-38. Hypothetical internal power dissipations of 0 through 5 kW are analyzed for comparison.

Assumptions used in the computer analysis are shown in Table 2.

Table 1. CTASC-II Equipment Power Demands

COMMUNICATIONS CENTRAL SHELTER (AN/MSC-75)

Nomenclature	(count)	Model Number	Power Demand (watts)
Chemical Agent Alarm	—	—	190
Light Bulb, Fluorescent	4	—	200
Console Printer	—	F 5100-13	negligible
High Speed Printer	—	F 5100-82	210
9 Track Mag Tape Device	—	—	260
8mm Cart Archive Device	—	—	negligible
Keyboard 1	—	—	
Display 1	—	—	
Operator Console	—	F3151-96	
Keyboard 2	—	—	170*
Display 2	—	—	
Central Processor Unit	—	—	
Power Switch Panel	—	—	
Blower Assembly	—	F-100-G	
F/O Multiplexer	—	OMNIMUX	
Communications Subsystem	—	—	
Digital Patch Panel	—	—	
Digital Power Module	—	—	
Digital Patch Unit	—	—	160*
MSE Level Converter	—	—	
VF Patch	—	—	
Modem Assembly	—	—	
Telecom Line Converter	—	TCC-10	
System Console VVT-124	—	F 5100-11	
Heater	—	P-13	not measured
Humidifier	—	—	400 (rated)**
Intercom	—	LS147F	15
Total Load for Shelter			1.6 kW
Air Conditioner, 36 kBTUH	—	CH405608	5.73 kW (cooling)

Table 1. CTASC-II Equipment Power Demands (continued)

COMPUTER SYSTEM, DIGITAL SHELTER (AN/MSW-122)

Nomenclature	(count)	Model Number	Power Demand (watts)
MAC Openet	—	—	
MAC Mux 5000	—	—	
Power Distribution Box	—	—	600*
Blower Assembly		F-1100-G	
Computer Power Supply		F4596-00	
F/O Multiplexer		OMNIMUX	
Light Bulb, Fluorescent	4	—	200
Disk Drive	(14)	—	1690
Cluster Controller	—	—	940
Unisys 5000/95	—	—	
8mm Cart Archive Device	—	—	negligible
Humidifier	—	—	400 (rated)**
Heater		R13	not measured
Intercom		LS147F	15
Total Load For Shelter			3.85 kW

SUPPORT SHELTER (AN/MYM-1)

Humidifier	—	400 (rated)
Power Distribution Box	—	negligible
Light Bulb, Fluorescent	4	—
Air Conditioner, 9 kBTUH		ECU9HC326
Total Load For Shelter		3.0 kW
Total Load For System as Tested		14.18 kW

*In cases where the system configuration prevented operation of individual pieces of equipment, the observed group consumption is listed.

**The team was unable to test the power consumption of the humidifiers, so the rated value is used.

Table 2. SAM Model Data

**SHELTER SYSTEM ASSESSMENT MODEL
WAT, POWER, AND WEIGHT REQUIREMENTS**

Env Parameters	Calculation details	Totals
Env Config. Envire.	BTU/Equip. : 0. 10 for AC, /Shelter: 0.07. 0.0 for Heat)	610/Btu
1 (CTASCII) ENVS	/Sensible & latent heat due to ventilation and personnel: 3405.	7622.0
Structures: SICPS		
Height: 130.0 ft	Lat:	0.00
St. AC:		
Other Settings	c) Equip: 0.00	
AC Htg. Cew. In. Inc. (C)	d) Bas/Batt, AC?:	
Total CRH: 20.0	e) Bas/Habitat, Hdg/AC, MaxCap?	
In. Interior Temp. 59. (°F)	Note: "0" accounts for the highest individual power consumer regardless of usage rate and includes the start-up factor.	
In. Interior Temp. 65. (°F)	Personnel Ht: 267 lbs	
	AC Height:	
	Equip Ht:	
	Computer Ht:	

CONFIGURATION DESCRIPTIONS					
CONFIGURATION: CTASCII					
Config description: 0- It is housed in a:					
PERSONNEL LOADING					
SEPARATE ATY LOAD (BTU/hr) LOAD (BTU/hr) VENTILATION WEIGHT/PERSON 1 315.00 315.00 20 267					

DATA FOR STRUCTURES					
NAME	TOP	SIDE	END	END	BOTTOM
Surface area (ft ²):	56.29	71.58	71.58	56.29	
B-factor (BTU/hr/ft ² /°F):	0.40	0.40	0.40	0.40	
Solar Absorb.(BTU/hr/ft ²):	0.70	0.70	0.70	0.70	
Angle with Horizontal:	0.00	0.00	0.00	0.00	
Area of Uninsulated:					
Penetration by Conduits(1):	0.00	0.00	0.00	0.00	
Height (lbs):					
Mass (pounds) (BTU/lb/°F):					

ENVIRONMENT CHARACTERISTICS				
ENVIRONMENT NAME	TEMPERATURE OUTSIDE (°F)	HUMIDITY OUTSIDE (%)	WIND SPEED (mph)	GND LOAD (BTU/HR/ft ²)
ENV1	120.0	3.0	0.9	231.0
				145.0

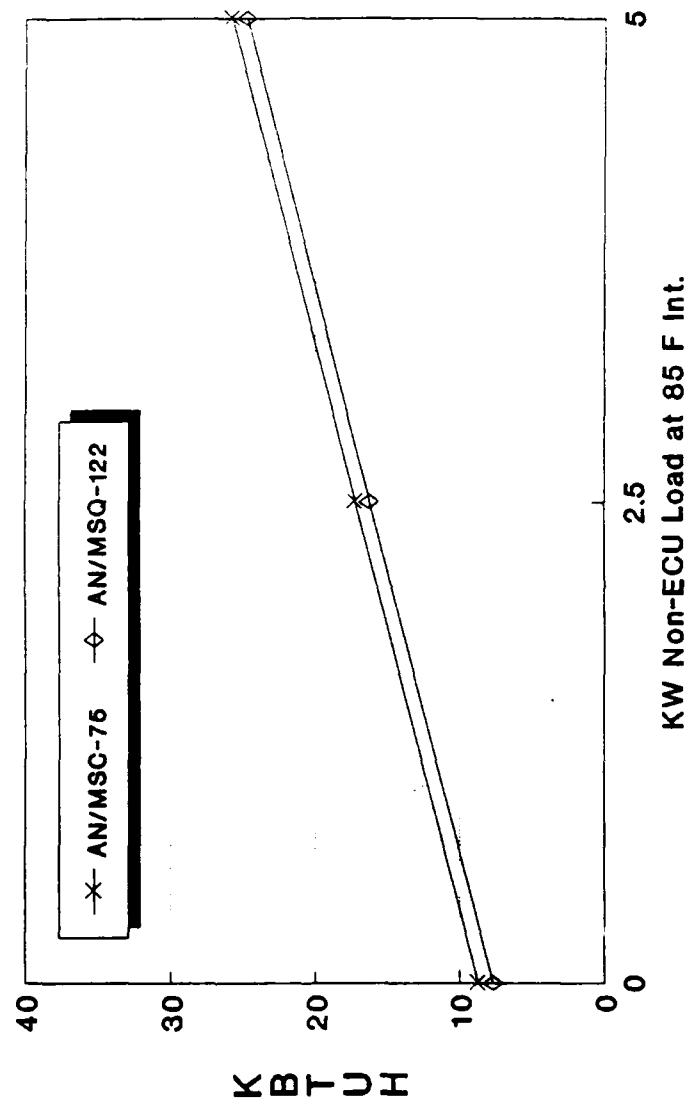


Figure 2. CTASC-II Shelter Cooling Requirements

Section V

Findings

The total power demand of CTASC-II was measured at 14.18 kW. However, the demand can be somewhat higher if all equipment is present and operational, or is located in a hot environment. Since CTASC-II is designed to connect to a headquarters generator, it is unnecessary to confirm the appropriateness of a generator assignment.

The internal power dissipation of the AN/MSC-75 shelter was 1.60 kW, which corresponds to a cooling load of 13.9 kBTUH (see Figure 2). The AN/MSQ-122 shelter produced 3.85 kW of internal power dissipation, which corresponds to 20.8 kBTUH. The shared 36 kBTUH air conditioner should be able to meet the demands of both shelters, even in the desert environment. The use of camouflage netting is always advisable to reduce solar heating during peak cooling hours.

Appendix



SR90-162

December 5, 1990

Special Report

**Air Conditioner Requirements Review
Power Consuming Equipment Inventory
Corps/Theater ADP Service Center**

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SPECIAL REPORT
AIR CONDITIONER REQUIREMENTS REVIEW

CTASC II ASSESSMENT

INTRODUCTION

This special report on data collected has been prepared to provide Belvoir Research, Development and Engineering (RD & E) Center's Systems Assessment Team selected information about the TACMIS system, CTASC II, an Army equipment designated by U.S. Army Ordnance Center and School (Letter, ATSL-CD-MS, Subject: Air Conditioner Requirements Review, dated 19 September 1990) as a system suited to provide input to an air conditioner requirements analysis.

PROGRAM OVERVIEW

The collected information from each of nine systems will be summarized by the Systems Assessment Team in a concise, meaningful form, and conveyed to the Training and Doctrine Command (TRADOC) Air Conditioner Requirements Review (ACRR) Team at the U. S. Army Ordnance Center and School for consideration as the team addresses and recommends attributes for a new standard family of tactical air conditioners.

The specified systems are:

TACFIRE	-Fire Direction Center, Artillery
FAADS	-Forward Area Air Defense System
JTIDS	-Joint Tactical Information Distribution System
SICPS	-Standardized Integrated Command Post System
MSE	-Mobile Subscriber Equipment
PATRIOT	-Air Defense Missile System
DAS3	-Decentralized Automated Service Support System
HAWK	-Air Defense Missile System
TACMIS	-CTASC-II (Corps/Theater ADP Service Center)

Coordination to gain access to the CTASC II was done at program manager level.

DATA COLLECTION INFRASTRUCTURE

The data collection phase of the Air Conditioner Requirements Review program utilizes Belvoir's Tactical Assessment of Power (TAP) Sample Data Collection (SDC) program. The TAP program was selected to support the ACRR program because all of the field data can be obtained in similar fashion and without adding additional people.

TAP is supported in the field using the contracted support infrastructure for SDC. COBRO Corporation provides the support to TAP and to ACRR through its offices at Fort Belvoir, Fort Bragg, Fort Hood, and others, depending upon where the target systems can be located.

DATA OBJECTIVES

The collection is focused on the equipment listed under Program Overview. The purpose is to develop detailed data on tactical power consumers, tactical shelters, tactical air conditioners mounted on the tactical shelters, shelterized system crew staffing, system environmental capability, system operating profiles, and crew training and experience.

COLLECTION METHODOLOGY

Data are collected on site by a team of people organized to perform a subsystem inventory, conduct a controlled, power-up procedure, measure operating and environmental parameters, and debrief operators about their training on the system, their field experience with the system, and the system's operating modes.

This system was inventoried and power consumption measured under a controlled power-up sequence. Military operators were not available due to the fact the CTASC II assessed is a prototype system and not yet issued to field units.

The data collection team consisted of a Senior Technician and an Engineer from the Systems Assessment Team at Fort Belvoir. The COBRO Senior Technical Analyst for the COBRO TAP SDC Program at Fort Belvoir completed the team.

At the field site the team accomplished the following:

Assistance of the system operator was solicited to identify the separate power consuming subsystems/components of the system housed in each shelter. The inventory data was posted to the Power Using Inventory form (Figure 1).

The interrelationships and power supply lash-up was reviewed as a basis for developing a measurement test plan. The plan was posted to the Power Measurement Load Configuration form (Figure 2) as a sequence of power-up events. Results were posted by input power phase (A, B, and C) to the Power Generator Performance Data form (Figure 3).

Notes about shelter size, trailer information, prime movers, generators, and air conditioners were taken.

The collection team reviews the information gathered and conducts an initial analysis to insure values of voltage, current, and wattage are available for each component; measured directly or calculated from other measured values.

Line item number (LIN), stock number (NSN), and nomenclature files are researched to identify the inventoried power consumers to as much detail as is available.

POWER ANALYSIS

Values recorded on the Power Generator Performance Data Form are verified by the Systems Assessment Team at Fort Belvoir using procedures calculated to establish the power values to be used later in Fort Belvoir's Shelter Systems Assessment Model (SAM).

SAM will be utilized to determine cooling requirements to maintain Human Engineering habitability conditions (MIL-STD-1472) at various climate conditions.

CTASC II DESCRIPTION

CTASC II (Corps/Theater ADP Service Center) is a new, tactical, shelterized automatic data processing (ADP) support system undergoing development for application at the Corps/Theater level. It is designated the AN/MYQ-6, Corps/Theater ADP Service Center. The AN/MYQ-6 is configured in three S-250 sized, all weather, shelters mounted to the frames of three CUCV trucks. The AN/MSQ-122, Computer System, Digital and the AN/MSC-75, Communications Central, comprise two of the shelters, while the Support Shelter, AN/MYM-1, occupies the third. Each CUCV tows a 1 1/2 ton cargo trailer.

The CTASC II system inventoried is identified as Corps/Theater ADP Service Center, AN/MYQ-6. Line Item Number F55750, NSN 7010-01-017-7040. It is assigned to the Regional Support Center at EER, Telegraph Road, Alexandria, Virginia. The system is not provided with its own generator. In garrison it is powered from a commercial power disconnect. In the field it is slaved off a headquarters generator. Power is distributed among the shelters via the DISE (Distribution Illumination System Electrical).

Cooling for the shelters is supplied from two air conditioners. The AN/MYM-1 has a front-mounted, 9,000 BTU unit on the shelter. The AN/MSQ-122 and the AN/MSC-75 share a 36,000 BTU unit carried on one of the support trailers. Flexible ducting is used to circulate air into and out of the shelters. Blowers at the bottom of the equipment racks force air up and around the racked components.

CTASC II POWER CONSUMING EQUIPMENT

Most of the computer components, auxilliary equipment, and some of the shelter support equipment, are commercial items adopted for the CTASC II requirement. The resulting configuration functions primarily as a mainframe computer (fourteen, gigabyte-sized, disk drives) which are accessed via the system's communications by large numbers of PCs operating in the supported headquarters.

Communications Central, AN/MSC-75. The AN/MSC-75 provides an operator position for the system. System operation and technical control is accomplished by the operator using an integrated PC. Communication channels are established via fibre optic cabling between elements and by internal patchboards. This shelter also provides for archiving of files and data transfer via magnetic tape. A heater, separate from the air conditioner unit, a humidifier, and intercom unit are also included.

INVENTORY

<u>System Code</u>	<u>Line Number</u>	<u>Nomenclature</u>	<u>Model</u>	<u>Stock Number</u>
AX036	None	Power Switch Panel	None	SKECTAScIII1160-M
AX037	None	Blower Assembly	F-100-G	None available
AX038	None	8mm Cart Archive Device	None	PCSA-551957
AX039	None	9 Trk Mag Tape Device	None	9271
AX040	None	F/O Multiplexer	OMNIMUX	932107
AX041	None	Communication Subsys	None	None available
AX042	None	Digital Patch Panel	None	806M00240316
AX043	None	Digital Power Module	None	DPM-5163
AX044	None	Digital Patch Unit	None	DPU-2403
AX045	None	VF Patch	None	JC-2/48M
AX046	None	Modem Assembly	None	AC-181600-100
AX047	None	Telecom Line Converter	TCC-10	SD4001
AX048	None	MSE Level Converter	None	A3134503
AX049	None	Console Printer	F5100-13	AP1329
AX050	None	System Console VVT-124	F5100-11	None available
AX051	None	Keyboard	None	2839879-10
AX052	None	Display	None	T3629-00
AX053	None	Operator Console	F3151-96	None available
AX054	None	Keyboard	None	None available
AX055	None	Display	None	29354
AX056	None	Central Processor Unit	None	T3618-00
AX057	None	High Speed Printer	F5100-82	1141
AG042	None	Heater	P-13	4520-00-177-6198
AX058	None	Humidifier	None	1383-1
BG001	K94880	Intercom	LS147F	5830-01-008-3126
AA024	None	Light Fix, Fluorescent	1 Bulb	None available
AO008	None	Power Distribution Box	None	None available
AK037	A24763	Air Conditioner	CH405608	4120-01-122-0628

Computer System, Digital, AN/MSQ-122. The AN/MSQ-122 consists of the disk drives and controllers for the ADP system. Blowers installed at the bottom of the racks force cooled air up and around the racked components. The shelter contains a heater, humidifier, and intercom.

POWER CONSUMING EQUIPMENT

<u>System Code</u>	<u>Line Number</u>	<u>Nomenclature</u>	<u>Model</u>	<u>Stock Number</u>
AX037	None	Blower Assembly	F-1100-G	None available
AX059	None	Disk Drive	None	P8514-84SCSI
AX060	None	Cluster Controller	None	2876878-00
AX040	None	F/O Multiplexer	OMNIMUX	932107
AX061	None	Unisys 5000/95	None	3108-53
AX062	None	Computer Power Supply	F4596-00	2836187-137
AX038	None	8mm Cart Archive Device	None	PCSA-551957
AX063	None	MAC Openet	None	2837363-01
AX064	None	MAC Mux 5000	None	None available
AO008	None	Power Distribution Box	None	None available
AX058	None	Humidifier	None	1383-1
AG042	None	Heater	P-13	4520-00-177-6198
AA024	None	Light Fix, Fluorescent	1 Bulb	None available
BG001	K94880	Intercom	LS147F	5830-01-122-0628
AK037	A24763	Air Conditioner	CH405608	4120-01-122-0628

Support Shelter, AN/MYM-1. The MYM-1 provides an on-site maintenance support facility. It provides the workspace and some spares and tool storage. Other spares and equipment are carried in the towed 1 1/2 ton cargo trailer. This shelter has its own 9,000 BTU air conditioner.

POWER CONSUMING EQUIPMENT

<u>System Code</u>	<u>Line Number</u>	<u>Nomenclature</u>	<u>Model</u>	<u>Stock Number</u>
AX058	None	Humidifier	None	1383-1
AO008	None	Power Distribution Box	None	None available
AA024	None	Light Fix, Fluorescent	1 Bulb	None available
AK009	A23955	Air Conditioner	ECU9HC326	4120-01-193-4998

DEBRIEFING

No debriefing was conducted during this assessment. The equipment was located in a Regional Support Center. None of the CTASC IIs have been assigned to CONUS units.

Figure 1. System Inventory Form

Power Measurements Data Matrix

Power Measurement Load Configuration

Date / /
Page -- 01

The diagram illustrates a memory system architecture. On the left, a vertical line labeled "System" connects to the top-most horizontal line, which represents a memory cell. Below it, another vertical line labeled "On/Off Config." connects to the bottom-most horizontal line. From the top-most horizontal line, a series of diagonal lines extend downwards, representing a search or read operation across multiple memory cells.

Figure 2. Power Measurement Load Configuration

Power Measurements Data Matrix

Power Generator Performance Data

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Date / /

Figure 3. Power Generator Performance Data

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